to Physicians.

Technical Report:
Impact of the Resource-Based Relative Value Scale on the Volume and Intensity of Physician Services

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IMPACT OF THE RESOURCE BASED RELATIVE VALUE SCALE ON VOLUME

Overview

Medicare policymakers have long been dissatisfied with the current method for determining levels of payment for Part B physician services under Medicare. The current customary, prevailing, and reasonable (CPR) system pays different amounts for the same services to different physicians; bases those prices in part on charges, current or past, that the physician makes to non-Medicare customers; and can permit some physicians to increase what they are paid next year by increasing their price this year. In the views of many, the current system is excessively complex, inflationary, and unfair.

It is easy enough to criticize current methods, but more difficult to develop an attractive alternative. The current leading candidate to succeed the CPR system is one which would set relative fee levels based on some measure of "resource cost" for different procedures: the Resource Based Relative Value System (RBRVS).

Since the recent Physician Payment Review Commission Annual Report draws parallels between a Medicare RBRVS and pricing in competitive markets and their presumed maximal efficiency, we begin by describing the ideally efficient point in the context of such markets. What is the efficient point, and what is required for competitive markets, in theory, to achieve it?

The paradigm is fairly simple. Assume that perfectly informed buyers pay the full price of medical care services, and assume that there is free entry into the production of such services. Then the following conclusions can be obtained:

a) The quantity such buyers demand is the optimal quantity in the sense that it includes all services for which benefit exceeds cost.

b) Price is optimal in the sense that it is equal to marginal resource cost at the optimal quantity.

c) Quality is optimal (but probably not maximal), given its cost.

d) Costs are minimized for whatever quality and quantity of care is produced.

In this hypothetical equilibrium, the marginal value consumers attach to services equals their price, and the price in turn equals marginal resource costs.

No one believes that real world medical markets could ever be exactly like this ideal, but it nevertheless serves two functions, one more appropriate than the other:

- It serves as a benchmark or standard by which to judge the actual or forecasted outcome of more feasible systems. Indeed, much of the

confusion in the debate over physician pricing can be traced back to a failure to define clearly what the ideal outcome is.

- It serves to indicate a set of characteristics at least some of which might be approximated in reality; "movement in the direction" of the ideal would be worthwhile.

The problem with the second approach is that it clashes with one of the important lessons of economic theory: the so-called "theory of second best." That theory says that, compared to a situation in which none of the competitive conditions are satisfied, achieving some, but not all, of the conditions of competitive equilibrium may actually make matters worse rather than better. Half of the competitive loaf can, in theory, actually be worse than nothing at all; "approximating" some of the competitive condition can actually reduce efficiency. This does not, we should hasten to add, mean that achieving some of these conditions is not often (or usually) efficiency-improving; it only means that theory is insufficient for a definitive conclusion. There are some potentially relevant examples: If price is increased for a service which currently commands a relatively low reimbursement per unit of resources used, so that the price bears a closer relationship to relative resource cost, but the service is one for which consumer ignorance makes demand creation especially easy, the outcome can actually be worse. We are not asserting here that we know this to be the case for the services where relative prices are increased by RBRVS; we are only saying that such possibilities as this must be watched for. Theory alone is not enough.

With these cautions in mind, we can review possible models of physician behavior, and use them to describe the response to RBRVS-based pricing.

Relative Prices and Relative Costs in a No-Demand-Creation Model.

We first describe a hypothetical market equilibrium with a single public buyer facing unlimited demand. We assume that the Medicare price must be accepted on assignment and that, for simplicity, only physician time is used to produce physician services. Finally, we first deal with the benchmark case in which physicians are assumed to maximize their real incomes. This model is not necessarily realistic (though we do not know whether or not other models are more realistic), but it does provide a point of reference. The target income model, to be described in the next section, is to be contrasted with this model. The physician is assumed to maximize a "real income" utility function in money income Y and leisure L.

$$U = U (Y, L)$$

The production function is given by $Q = Q_M + Q_N = g(W)$, where W is physician hours worked (equal to $24 - L$ per day), Q is total quantity, Q_M is Medicare quantity, and Q_N is non-Medicare quantity. Let P_M be the Medicare price, and let $Q_N = Q (P_N)$ be the non-Medicare demand curve as a function of the non-Medicare price. We initially assume that all physicians are participating, so

that the price Medicare pays determines the price the physician gets.[1] Then equilibrium requires that the following holds for every service i.:

$$P_M^i = (u_L/u_Y)\ (1/g_i') = MR_N^i$$

where MR_N^i, the marginal non-Medicare revenue from service i, equals

$$P_N^i + (\partial P_N^i/\partial Q_N^i) \cdot Q_N^i.$$

This expression indicates two alternative measures of cost in equilibrium: the (money) value of the leisure that must be sacrificed to produce one unit of service and the opportunity cost of using that time to produce services for non-Medicare patients. The term $(1/g_i')$ is the marginal time cost per unit of output which Hsaio estimates.

We also need an equilibrium condition across services. We can assume that the money value of a unit of lost leisure, or u_L/u_Y, is the same for all services. For every pair of services i and j, we then require that

$$\frac{P_M^i}{P_M^j} = \frac{g_j'}{g_i'} = \frac{MR^i}{MR^j}$$

This can be rewritten as:

$$P_M^i g_i' = P_M^j g_j' = MR^i g_i' = MR^j g_j'$$

This equality says that Medicare price received per unit of leisure time sacrificed to produce a service must be equal across services, as must marginal private revenue per unit of time. In other words, work time must yield the same money return per minute in all uses. This is, it should be noted, an equilibrium condition; in the long run it must hold, and the system in the short run must be moving toward it, if the assumptions made in the model are valid.

However, one of the premises of the proposal to base prices on RBRVS is that this equilibrium condition probably does not fully hold--that there are now and have been for some time services supplied in positive amounts with the same time cost but different levels of net Medicare prices, and therefore different levels of net return per unit time. But Medicare prices which do not all currently equal costs are inconsistent with equilibrium in this model. The equilibrium condition implies that, if two services of equal cost do not carry the same Medicare price, if there is unlimited Medicare demand, and if physicians only maximize real income, the physician will supply only the more lucrative service. Putting time into the lower profit service will reduce income, compared to putting all time into the higher profit service. If we

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[1] Even if the physician does not participate or accept assignment, this model will still be relevant if increasing Medicare's reimbursement increases the price the physician collects, and demand is unaffected.

do in reality observe positive supply of the lower profit service, at least one of the assumptions in this model must not hold.

For the moment, we therefore remove the assumption that the demand for Medicare services is unlimited. Instead, we assume that there are limits to the amount of any one service that even Medicare patients will accept; demand can be satiated and doctors may wait for patients who never come. Higher priced services (relative to cost) therefore must display no shortages, no excess demand.[2] For these services, physicians are satisfying all of the demand there is and would be willing to supply more demand if that demand existed. With this modification, the new equilibrium statement is that the equilibrium condition equality must hold only for those services for which there _is_ unsatisfied Medicare demand. For the other services, there is excess willingness to supply and quantity is constrained by demand. We assume that, for every physician, there are at least some such "excess supply" services.

We call P_M^S the Medicare price of a service in excess supply, and P_M^E the Medicare price of an "equilibrium" service for which there is excess demand or for which Medicare demand just equals supply.

We now analyze the effects on volume of changing P_M^S and P_M^E. Suppose P_M^{Si} is reduced for some service i. As long as the price is not reduced below P_M^{Ei}, the conclusion is simple: there will be absolutely no effect on Medicare volume. The only consequence of a price reduction is to reduce the income (and profit) of the physician. Whether the service is expensive or costly, relative to time, there is _no_ volume impact. The reason is that, since the price exceeds the amount needed to induce enough supply to meet demand, a drop in price, though it may reduce the quantity physicians want to supply, will not cause volume to fall, since demand rather than supply determines volume.

Things are different for changes in P_M^{Ej}, the price of a service j which initially is in equilibrium or excess demand. If the price for such a service is decreased, the volume of such services _will_ be decreased, since a profit-maximizer will not supply a unit when price falls below marginal cost. If the price is increased, volume will increase as physicians move along their supply curves. Moreover, if the Medicare price cuts reduce Medicare volume, the price in the private market will also be cut, in order to encourage larger amounts of the now more-profitable private business. That is, there will be "negative cost-shifting". In this case, there need be no concern that physicians will raise prices to others to make up for lower Medicare prices.

The message thenn is straightforward. If doctors maximize real income and do not create demand, the for those services for which $P_M > P_M^E$, changes in prices serve only to redistribute rents. They do not affect actual resource costs, either for physician services or other services which may be complements or substitutes for those services. But for those services for which $P_M \geq P_M^E$, price cuts _do_ reduce volume, and price increases volume if

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[2] An implication of this result is that if there is unsatisfied demand for some Medicare services at current Medicare price levels, price for that service _cannot_ be exceeding true cost, regardless of what Hsaio-type research shows.

there is excess demand or if doctors can induce demand (as we shall see), relative price change can have an effect.

All of this analysis has taken specialty as given. We now examine the determinants of cross-specialty price effects. We suppose that only limited substitution is possible across specialties. Some services are common to pairs of specialties, while others can only be performed by only one specialty. (If there are no services in common, linking across specialties is impossible. We can only say that the impact of a price reduction depends on whether the services supplied by the specialty are supply-constrained or in excess supply.)

Let us assume that there is a common service across two specialties, but that it currently commands a higher Medicare price per unit time in one specialty than another. If the price of this service is equalized by being reduced for the high-priced specialty, then the question is whether other services in the high-priced specialty were in excess supply, and how their return per unit time is related to that of the linking services. If the other services have the same return, or if they are in excess supply, then there is again no impact on volume in this specialty. If some services display supply constraints, the volume will fall there. If the services in the high priced specialty are supply constrained, then the linking service for that specialty may be said to have a different cost than for the lower priced specialty.

One might also note an alternative legitimate definition of opportunity cost, though it is wholy ignored in the RBRVS approach. Consider two services which command different marginal revenues in the private market and have correspondingly different Medicare reimbursement rates. Even if the services take exactly the same time, and are identical in work, the higher-priced service nevertheless must have a higher opportunity cost, since the sacrificed revenues available from the private market alternative will be greater. In this sense, the "resource" cost for services to Medicare patients is, strictly speaking, irrelevant, since it does not represent the true opportunity cost, especially once training costs have been sunk. A computer programmer and a poet may both give up the same subjective value from an additional hour of lost leisure, but if the programmer's lost income from sacrificing work time is higher than the poet's, he has a higher opportunity cost and would require a higher price to devote an additional unit of time to some activity.

This same argument applies to physician services. We might well expect that a cut in the price of some specialty service which is currently high relative to cost in the private market will reduce the quantity of such services supplied to Medicare patients, even though the new lower price still more fully covers the Hsaio-method "cost" than is true for some other service.

The main message from this discussion is that, under the assumptions made, changing prices primarily redistributes income among doctors but does not change the volume for "overpriced" services. The reason is straightforward--since the price is so high that the physician was already rendering all of the volume his or her patients demanded, cuts in price do not manifest themselves as lower volumes until prices fall so low that physicians are unwilling to render as much service. Put slightly differently, with no

demand creation assumed it is no more "rational" to overpay at uniform rates per hour, as RBRVS would, than it is to overpay at different rates per hour, as of time. And yet all the RBRVS would do, even if done perfectly, would be to equalize the level of monopoly rent per time period. And the relevant measure of cost here is the revenue that could have been earned in the private market.

Again, let us note that these are not necessarily realistic predictions. They become realistic if there is little scope for demand inducement (as some, though by no means all economic studies suggest), and if doctors do not behave as the patient's full agent.

Adding Demand Creation

Many people suspect, however, that physicians do not accept patient demand as given. Instead, they may create demand. The empirical evidence on this critical question is not conclusive one way or the other, so that subjective guesses are all we have to go on). Doctors may persuade patients to accept more services than would have represented their best advice to the patient. In an intuitive sense, the net profit of the service provides the financial incentive to create demand. What is required for demand creation, however, is more than just a fiscal gain from creating demand. It is also necessary that the physician be able and willing to respond to that incentive. Here we base our analysis on what has been termed by Evans and Pauly as the sophisticated target income model.

Suppose, for simplicity, that demand-creation "ability" and "willingness" (to be described in more detail below) are the same for all services. Formally, this means that the proportional extent of demand creation is uniformly related to the profit per unit time for each service. If two services take the same amount of physician time but one has a price to time ratio higher than the other, the demand creation (as a percentage of total quantity demanded) will be greater for the higher priced service. If one service takes twice the time of another, but commands twice the price, both will contain the same proportion of demand creation.

Is "rationality" appreciably improved by an RBRVS which equalizes the extent of demand creation? It is clear that a preferable strategy would be one which removed the incentive for demand creation for all services. Since excess supply is caused by a price which is too high relative to cost, the most direct solution is to reduce all prices in absolute terms. Services with initial prices higher relative to cost would have their prices reduced more, but the main initial message is simple: reduce all prices until access problems show signs of developing.

There is obviously some price sufficiently low that price would not just be proportioned to marginal cost; it would equal marginal cost. This would be a "good" resource-based price. Compared to present prices, that price might well mean substantial declines in all physician incomes, in all specialties. It is, however, only this price, the one that equals marginal cost, which

replicates the competitive market. Even then, price equals cost is only necessary for efficiency, it is not sufficient.

The normative case for RBRVS which only adjusts relative prices and does not require reducing the multiplier to bring about equality must therefore be based on an argument that uniform demand creation is to be preferred to uneven demand creation. Demand creation, by definition, makes consumers worse off. The question is whether this damage increases at the margin as more demand creation occurs. Whether this is so--whether, for instance, more damage is done by excessive lab tests, surgery, or endoscopies, than by "excessive" office visits (and the potential for false positive findings), is ultimately an empirical question.

The answer will depend in part on what deters physicians from demand creation: is it a desire to avoid making patients worse off, or is it a desire to adhere more closely to appropriate clinical practice?

The critical question for this analysis, however, is whether RBRVS will have a predictable effect on volume and total expenditures. The impact of RBRVS on cost and volume is unpredictable, without specifying further (and without guidance from any empirical evidence) the precise relationship between price and the extent of demand creation. Under a revenue-neutral implementation of RBRVS with mandatory assignment, the price of physicians' services will increase for some services and decline for others, but the change (if any) in the total cost and volume of physicians' services is impossible to predict without adding some additional hypotheses.

Suppose one hypothesizes that (1) services for which prices are increased will experience increases in volume through more demand creation, and services for which prices are decreased will experience declines in volume through less demand creation, (2) the percentage change in volume of physician services is proportional to the percentage change in Medicare revenues per unit of service, and (3) services for which prices will be increased--largely diagnosis and treatment services -- are associated with lower levels of non-physician costs for complementary services. (These services would be covered under Part A as well as under Part B). Conversely, services for which prices are cut are assumed to be ones with high levels of complimentary inputs. Then one can describe an optimistic scenario in which movement to an RBRVS is accompanied by net declines in hospital, lab test, and (in the future) covered prescription drug expenditures, and therefore net program savings for Medicare. But is this scenario likely?

The scenario rests heavily on untested behavioral assumptions, some more subtle, but even more uncertain, than the ones explicitly made. We now explore these behavioral assumptions. One assumption has to do with the willingness of Medicare consumers to accept the newly more profitable services. Will consumers really be willing to accept--do they really want or can they be persuaded to want--the additional diagnostic and treatment services for which financial incentives will be strengthened? Was there unsatisfied demand for such services initially? One can be reasonably sure that there are no current apparent shortages of such services for Medicare patients in most markets, so that demand creation will be required if volume

is to change. On the other side, will consumers accept a decline in rates of more aggressive procedures? Perhaps not all will do so.

A more serious problem, in a conceptual sense, is the ambiguity of theoretical predictions from the sophisticated target income model about how physicians will respond, even when they are _not_ limited by consumer non-compliance. One unknown is the physician willingness to respond to financial incentives. Perhaps surgeons really believe in the usefulness of surgery, or are just trapped by the need to be consistent with their past practice style, and so will not cut back even if price is cut. Whether internists now feel that they are treating Medicare patients appropriately for diagnostic and treatment services, or whether they feel that low rates of current payment cause them to skimp on care which is really beneficial, is also not known. Do they really think that patients would benefit from more diagnostic and treatment services?

The most important source of ambiguity in this model comes about, however, because a price change has two different theoretical effects on physician incentives. A cut in price has two conflicting incentives - on the one hand, the physician will want to use fewer of the less profitable services and more of the more profitable ones to treat a condition--a _substitution effect_. On the other hand, if the service whose price is cut is an important part of his or her total business, the price cut will cause income to fall unless he or she can increase demand for other services. If income falls, the physician may create demand for the new lower-priced service to get his income back closer to the target level--_an income effect_. It is not possible to determine a priori which effect will predominate, and so not possible to determine whether aggregate volume will rise or fall.

Toward Simulation

What we can do, however, is examine the parameters which determine how physician behavior will respond, and to show the sensitivity of predicted response to those parameters. Here, I furnish a simple numerical example intended to illuminate the issues involved. To turn these thoughts into a complete scenario, one would also need to simulate the pattern of physician price and income change, and have estimates of elasticities based more directly on data.

The two important behavioral parameters are an _income elasticity_ of volume (output price effects held constant) and an _output price elasticity_. Let α denote the income elasticity and β the output price elasticity. The important "environmental" variable is the _concentration_ of price-increased and price-reduced services across physicians.

One would expect α to be negative: the lower the physician's income, the less value attached to the subjective cost of demand creation, the greater value attached to additional money income, and so the greater the extent of demand creation. One would expect β to be positive: the higher the price for a particular service, the more "profitable" the service becomes, and the more of it will be rendered. (Here we assume that income effects on physician

demand for leisure, as opposed to demand for accuracy of information, are small enough that supply curves do not bend backward.)

The possibility that reducing prices could increase volume requires an income effect; the income elasticity is the empirical manifestation of the target income idea. The target income idea also implies that uniformly higher malpractice costs, which reduces net income, should also cause higher volumes for those doctors continuing to practice. Examining the impact of this and other lump sum changes in doctor income would be an ideal way to measure the income effect empirically.

Now let us take a simple case in which there are two types of services, D and I, which currently carry equal unit prices for Medicare, and which are currently rendered in equal aggregate volumes; however, the time input for service D is less than that for service I. A static revenue neutral price change is one in which total Medicare payment levels would remain unchanged if volumes did not change. A decrease in the prices of the type D service which is just equal in percentage terms to an increase in the prices of the type I service would be static revenue neutral.

To illustrate the role of these parameters, let us consider as an example a revenue neutral price change of 20 percent. All type D services receive a 20 percent decrease in price, and all type I services receive a 20 percent increase in price. We also need to select values for the behavioral parameters. We choose $\alpha = -0.2$ and $\beta = 0.1$.

Table 1 displays simulated volume responses for physicians classified by the fraction of their initial volume which represents type-D services. Consider the first row. These physicians only provide type-D services. Their income thus falls by 20 percent when the prices for all the services they render falls by 20 percent. The effect of this decline in income alone would be to increase volume by four percent. However, since providing Medicare services now is less profitable, the price or substitution effect is to reduce services by two percent. The net effect is therefore an increase in volume of two percent (though the change in part B payments will be a decrease of 18 percent).

This example corresponds roughly to the empirical studies in which real Medicare price declines are estimated to have resulted in an increases in volumes. Note that a condition conducive to this happening is that α is greater than β, as in the example. (Note also that if price declines are to result in an increase in expenditures, it is necessary that $(\alpha\text{-}\beta)$ is greater than one. If, for instance, the two elasticities were equal, a reduction in price could never increase volume.) The other extreme case, of physicians providing only type-I services, shows a symmetric decrease in the volume of type-I services of two percent.

Now let us consider a physician who provides 80 percent type-D services and 20 percent type-I services. His or her income falls by 12 percent, which translates into an income effect of a desired 2.4 percent increase in the volumes of all services. For type-D services, the net impact of this income effect and the negative 2 percent price effect is a 0.4 percent increase in

volume. For type-I services, the net effect is to add a two percent price effect to the income effect, so the net increase would be 4.4 percent.[3]

For a physician with a 50 percent share in type-D services, the price change is revenue neutral as far as his or her practice is concerned. There is no income effect, and we see the expected two percent decrease in the volume of type-D services and two percent increase in the volume of type-I services. (However, since prices have been changed, part B payments for this type of physician will nevertheless increase slightly after the behavioral response, because the volume shifts toward the higher priced service.)

The rest of the table calculates similar values for other initial output shares. The table shows that the system-wide response to a budget neutral change in relative prices depends both on the parameters α and β and on the initial distribution of physicians by output mix. Table 2 shows three possible outcomes for the system as a whole. Depending on the distribution, the volume of type-D services can rise by two percent, fall by two percent, or change only modestly. There is even a distribution of outputs over physicians which would lead to zero volume effects following implementation of RBRVS even with demand creation possible.

This analysis could easily be made the subject of simulation by making more realistic assumptions about the change in price, and by using actual values for the distribution of physicians by change in income. The major message, however, is clear even from this analysis: the more concentrated in particular physician's practices are the services for which price is decreased, the more likely that the quantity of those services will increase. If, for example, RBRVS reduces the relative price of surgery, and if surgery makes up a large fraction of the services surgeons provide, a revenue-neutral RBRVS will be likely to lead to more surgery.

Indeed, the analysis suggests that, if one wanted to ensure that volume fell for price-decreased services and rose for price-increased services, one probably should implement a scheme which is revenue-neutral by specialty or by other characteristics that group physicians with concentrations of services whose prices are to be cut or increased. For instance, suppose one increases the prices for office visits and consultations for general surgeons,while reducing the price of surgical procedures sufficiently to permit surgeons' net income to remain unchanged. (This would, of course, require that surgeon office visits would be priced higher than, say, internist office visits of equal duration.) Then there would be no income effect for surgery, volumes of surgery would be guaranteed to fall, and volumes of surgeon office visits would surely increase. In this sense, specialty-specific revenue neutrality is a more promising approach to reducing surgery rates than is a scheme which tries to link services across specialities.

This highly simplified example shows the unusual character of volume responses to budget neutral relative price changes in a model with demand creation. Specifically, it shows the impact of concentration on the expected

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[3] We ignore second-order or interaction effects here.

responses. If services whose prices are cut tend to be concentrated in particular specialties, it is quite possible that their aggregate volume will increase, not decrease, and that total Medicare costs will be increased by RBRVS.

Volume Effects With Balance Billing

The analysis thus far has dealt with a change in payment that is directly linked to the prices physicians receive, and it has not considered the effects on consumer demand of changes in copayment when the gross price physicians receive is changed. This latter omission is perhaps reasonable for the 20 percent coinsurance, since more than 70 percent of the elderly have Medigap insurance to cover the coinsurance, and since the new catastrophic coverage added to Medicare will also limit this liability.

However, if physicians are free to charge more than the Medicare reimbursement amount when they decline assignment or refuse to become Medicare participating physicians, then there can be other effects on volume from implementation of RBRVS.

Let us begin with the simplest set of assumptions. We assume:

(1) Physicians do not change their total price when Medicare reimbursements change.

(2) Medigap insurance covers coinsurance but not any excess of charges over reimbursement.

Now we imagine that reimbursements are raised for diagnostic and treatment services and reduced for invasive services. The out-of-pocket charge in excess of reimbursement will then fall for the former and rise for the latter, and in ways not typically covered by Medigap insurance. If the person does have Medigap coverage of coinsurance, the effect is to change user price by a substantial proportion. Even with relatively small price elasticities, the net effect of changes in balance billing could be a sizeable drop in invasive services and an increase in diagnostic and treatment services. Indeed, one way to offset falling prices for surgery will be to add more diagnostic services; doing so may even reduce the need to raise surgical prices.

If we change assumption (2) and have the person pay the 20 percent coinsurance, there is an offsetting effect. Coinsurance will fall for invasive services whose price is decreased and increase for diagnosis and treatment services whose price is increased. The net effect of changes in coinsurance and balance billed amount on user price is directly related to the change in reimbursement.

What would one predict, on theoretical grounds, as the net effect of increasing coinsurance but reducing amounts billed in excess of reimbursement? If all physicians are identical, the net effect of a $1.00 increase in reimbursement would be to increase coinsurance by 0.20 but to reduce balance billing by $1.00, so that the net effect would be a drop in copayments of

0.80. Hence, we would expect that volumes of reimbursement-increased services would rise.

Things are more complicated if higher reimbursement can be accompanied by higher physician prices, or if physicians can change their decisions to accept assignment. If more physicians are willing to accept assignment when reimbursements are increased (because the administrative cost advantages become more predominant), then it is probably even more likely that the volume of reimbursement-increased services will rise and the volume of reimbursement-reduced services will fall. In contrast, if physicians raise their billed prices dollar-for-dollar as reimbursements are raised, then there is no impact on the willingness to accept assignment _or_ the level of charges in excess of reimbursements. The only effect of RBRVS would then be an increase in coinsurance for reimbursement-increased services, (and an expected _decline_ in volume) and a decrease in coinsurance (and an _increase_ in volume) for reimbursement-reduced services. In this case, a cut in surgical fees, by lowering coinsurance, would increase the quantity patients would demand, a result that may clash with the desires of the "target income" physician.

It would be possible to simulate these alternative scenarios, given some assumptions about the impact of reimbursement levels on prices and on assignment decisions. There is some empirical literature on the assignment question, but little on the pricing question.

Empirical Evidence of Volume Effects

Is there any empirical basis for speculating about the effects of RBRVS-based changes in Medicare reimbursement policy? The best study to date of the effects of changing Medicare prevailing charge limits has been provided by Rice and McCall (1982; 1983). They examined the natural experiment provided by a change in the definition of prevailing charge limits in Colorado in 1976. As a result of moving to a single statewide limit for different limits for different subareas within the state, there was a variation across the state in the percentage rate of increase in those limits. The investigator examined the relationship between the rate of increase in the prevailing charge limit in an area and three "dependent" variables:

(1) the percentage of Medicare services for which assignment was accepted;
(2) the reasonable charge the provider set; and (3) the intensity of services, measured as the number of medical services of different types per medical service. (They did not examine the intensity of surgical services.) The main findings were that doctors in those areas in which prices increased less rapidly than average experienced a larger reduction in assignment rates and a smaller increase in reasonable charges. Doctors whose reasonable charges rose less rapidly experienced larger increases in intensity than did doctors who experienced large increases in reasonable charges.

There was no consistent relationship between increases in reasonable charges and charges in laboratory tests or radiology procedures per relative value unit.

The authors interpret their results as consistent with a sophisticated target income model of physician behavior, and they are certainly right. The results consistent with a view that those doctors whose members would otherwise have grown less rapidly were more willing to suggest more intensive medical procedures for medical services, and less willing to accept assignment.

This consistency should not, however, obscure some things that were not found and which reduce the relevance of this research to predict the impact of RBRVS.

(1) Then research does not deal with changes in relative prices, as would a balanced budget implementation of RBRVS; it deals only with a change in absolute price.

(2) The research does not show that increases and decreases in prevailing limits have opposite effects on volume or intensity. Rather, there was an increase in prevailing levels for all areas; the difference in effects was related to the size of the increase.

(3) The research does not show that larger price increases induce decreases in total physician volume, or that smaller price rises induce increases, because the research did not measure any effects in the number of medical services. Total volume (measured in RVUs) is the product of RVUs per service (which the research did measure) and total number of medical services (which it did not measure). A decline in the latter could offset a rise in the former. Also, the research did not investigate the market for surgical services.

At a more general level of modelling, the research did not examine the relationship between the dangers in prevailing limits and either assignment intensity. Instead, it showed that there was a positive relationship between the change in the limits and average reasonable charges, and then studied the relationship between the change in a given doctor's reasonable charge and his intensity or assignment outcomes.

This two-step procedure is not equivalent to estimating the direct relationship between the prevailing limit and the dependent variables, because there is no reason to assume that the error terms in the two regressions are independent, nor did the authors check this. Intuitively, it is clearly possible that all of the doctors induced to raise their reasonable prices by charges in the prevailing limits did not change their assignment or intensity but that these changes were linked to doctors who charged their reasonable prices for other causes. We know that such "unexplained" reasonable price charges occurred, because prevailing charge changes explained only about 10 percent of the variance in the change in reasonable charges.

The regression with the change in reasonable prices as a right side variable is suspect in any case, since the doctor controls his reasonable price; it is endogenous. This raises the possibility of bias, though the bias cannot be signed. The authors should have used a predicted value of reasonable price changes in a simultaneous equations system or, simpler yet,

just used the (exogenous) change in prevailing price limits to the right side variable.

There is also a potential "index number" problem in the procedure followed. The reasonable price variable is the average reasonable price per RVU. This would rise if the mix of services a doctor delivers did not change, and he raised one or more of his prices, this is the interpretation the authors intended. But suppose that the price per RVU varies across procedures, and he changes his mix of procedures. Then the variable "reasonable price per RVU" could change, even though there was no change whatever in any price. Bias would arise if there was a systematic relationship between RVUs per service and dollars per RVU. If RVUs per service tended to fall (rise) with increased complexity, the coefficient on the variable would be biased downward (upward).

Finally, the estimated elasticity of intensity with respect to reasonable price is less than negative unity. This means that, although intensity rises when price falls, it does not rise by so much (number of services held constant) as to offset the effect of a price cost. Price costs that are large enough will reduce total expenditures.

Conclusion

The theoretical ambiguity of volume effects under RBRVS is pervasive. At least policymakers need to know that anything (or nothing) can happen. In large part the answer depends on what one assumes about the prospects for demand creation--a question which itself is far from settled, especially with regard to price changes. Some simulations would, I believe, be a striking way of illustrating the possibilities.

Table 1

Impact of Budget Neutral RBRVS on Physician Services Volume, by % of Practice Affected

% of Volume in Services With Decreasing Price	% ΔY, No Response	% Income Related ΔV	Net % ΔV, Type-D	Net % ΔV, Type-I
100	-20%	+ 4%	+ 2%	N.A.
90	-16%	+3.2%	+1.2%	+5.2%
80	-12%	+2.4%	+0.4%	+4.4%
70	- 8%	+1.6%	-0.4%	+3.6%
60	- 4%	+0.8%	-1.2%	+2.8%
50	0	0	- 2%	+ 2%
40	+ 4%	-0.8%	-2.8%	+1.2%
30	+ 8%	-1.6%	-3.6%	+0.4%
20	+12%	-2.4%	-4.4%	-0.4%
10	+16%	-3.2%	-5.2%	-1.2%
0	+20%	- 4%	N.A.	- 2%

Table 2

Summary of Aggregate RBRVS Volume Effects

Volume Distribution	Net % ΔV_D	Net % ΔV_I
All Physicians 50% type-I Volume (V_I) and 50% type D volume (V_D)	- 2%	+ 2%
All Physicians Either 100% V_D or 100% V_I	+ 2%	- 2%
Physicians Either 80-20 or 20-80, equal numbers of each type of physician	-0.66%	+0.66%

Appendix: Illustration of Volume Impacts

Calculation of Volume Impacts of Balanced-Budget RBRVS Implementation Based on Hsaio's Simulations

Introduction

As part of his study of resource based relative value scales, Hsaio has simulated the effect of a balanced budget switch to RBRVS on total Medicare payments to different specialties. Neither Hsaio's published work nor his reports furnish enough information to make precise calculations about the effect of these changes on volume of Medicare services. But his estimates do provide a clear way to indicate what the critical variables are for applying the model described in the text.

Hsaio's study provides estimates of the changes in relative Medicare reimbursements for a selected set of procedures, grouped by the broad procedural types of evaluation/management, invasive (hospital), invasive (outpatient), pathology, and radiology. Setting the last two types of services aside, it would be reasonable to enquire about the changes in volume for all services in each of these three broad prodedure types by physician specialty. That is, one might want to know what would happen to general surgeons' evaluation/management volume, their inpatient invasive volume, and their outpatient invasive volume. And one could ask the same question for other medical and surgical specialties.

We could assume, as does Hsaio in part of his simulation, that payments for similar procedures would rise by similar percentage amounts. To calculated an estimated average price change for each of the three broad categories of services, we would need to know the relative volume of each priced service, so we could calculate a weighted average price change. (An important technical question is which kind of price index is in fact the best to use.) We also need to know the total volume of each of the broad classes of outputs. If we are willing to simulate an arrangement with participating physicians, these numbers should tell us the change in relative prices for each of the broad classes of services for Medicare patients. Given some estimate of substitution elasticity, we could then estimate the percentage change in volume of each type of services that would represent the substitution effect.

The other important empirical measure is the volume of Medicare business as a percentage of the doctors total volume of services. If, for instance, Medicare is 50% of a doctor's volume, and Medicare expenditures fall by 42%, then the doctor's total income falls by 21%. When multiplied by an income elasticity, this would yield an estimate of the income effect.

To indicate some approximate values for a simulation, we estimate the average change in price from the current price to an RBRVS-based price to be proxied by values for an intermediate office unit (rise in price from 0.33 to 1.00) for evaluation and management services. We used the decline in price for bypass surgery (from 1.62 to 1.00) as the estimate for invasive services.

Given the overall percentage change in Medicare payments to each specialty that Hsaio has calculated, we can estimate the approximate percentage each of these types of services represents of total Medicare services to that specialty (a decline of 40%).

Table A-1 shows the impact of these price and income changes on surgery volume for two specialties, under the assumption that $\alpha = 0.2$ and $\beta = 0.1$. The surgery rate (and total volume) would increase by 8 percent for thoracic surgeons, but it would fall by 1.5% for general surgeons. One would need information on the distribution of total volume across specialties to calculate an impact on total surgical volume.

Were the difference between substitution and income elasticities larger there would be more likely to be an increase in surgery volume. For instance, if the income elasticity was 0.5 (doctors make up in volume about half of income loss), then volume for thoracic surgeons would rise 20%, and that for general surgeons would now increase by 4.5% since the income effect alone would lead to 9% increase in surgery.

Conclusion

These results suggest that the impact of RBRVS would be a modest decline for general surgery and an increase in thoracic surgery. Empirical investigation of the relevant elasticities is critical in order to obtain more reliable estimates.

Table A-1

Sample Calculations of RBRVS Effect on General Surgery and Thoracic Surgery

Assumptions

$\alpha = -0.2$
$\beta = 0.1$

% Δ p, Surgical Services -40%

	GS	TS
% Surgical Revenue	90	99
% Δ Income	-18	-40
% Income-related Change in Surgery	+3.6%	+8.0%
Substitution-related Change in Surgery	-4.5	0
Net Change in Surgery	-1.5%	+8.0%

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